Other: Performance Verification of Nonresidential Systems and Equipment

Description

Although many new buildings in California meet or exceed the energy code[1], there is a significant gap between the intent of the design and actual building performance. A study of 60 commercial buildings found that more than half suffered from control problems, 40% had problems with HVAC equipment, and one-third had malfunctioning sensors. An astonishing 15% of the buildings studied were missing specified equipment, and approximately 25% of them had malfunctioning energy management control systems (EMCS), economizers, and/or variable speed drives.[2] Performance verification is aimed at reducing these problems in new buildings constructed in the state of California.

Performance verification can more effectively ensure code compliance and help determine whether equipment meets operational goals or could be adjusted to increase efficiency and effectiveness. It has three basic elements that will be included in code requirements:

- Documentation that will enable the installation of monitoring points used in the verification of measure performance,
- Test requirements that determine if an installed system or equipment meets the intent of the code, and
- Requirements for who is allowed to perform the tests to verify performance.

This process will be implemented through certified third-party entities. These individuals will be responsible for performing both plan review and field verification to certify the performance of measures required by the *Standards*. For some measures, the Building Automation System (BAS) may be utilized as a tool for performing measure verification.

Benefits

Verifying the performance of measures will produce both energy and non-energy benefits.

The energy benefits will be assessed through a process of analyzing the measure in a failure mode, and then in a normal operational state. Each measure will then be assigned two probability values: one for normal operation and one for failed state. A model will be developed using the Nonresidential New Construction Database to determine statewide impacts based on these failure modes, and the net-present value (NPV) of the cost of failures will be identified. This work will be done in conjunction with the other 2005 *Standards* analysis.

For example, a preliminary analysis of economizer failures by PG&E shows a NPV of $187 million statewide, or $6,500 per HVAC unit, assuming that 10% of economizers fail while open, with the remaining units failing in the closed position (100% overall failure rate).

The non-energy benefits associated with verifying the performance of measures include improved health and safety, reduced environmental distractions, and a more comfortable building that may result in improved worker satisfaction.

Environmental Impact

This measure will not have any adverse environmental impact.

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[1] This refers to the Energy Efficiency Standards for Nonresidential Buildings contained in Title 25, Part 6 of the California State Building Code.

[2] PECI. 1997. *Commissioning for Better Buildings in Oregon.* Oregon Office of Energy.

Type of Change

Mandatory Measure	This change would require all plans to identify specific monitoring points that will facilitate verifying the performance of a measure.
Prescriptive Requirement	This change would require two types of changes to the prescriptive approach. The first change would require that if the following measures are installed for credit, they then pass certain tests to verify their performance: ▪ Chilled Water Systems ▪ VAV Systems ▪ Package HVAC Systems ▪ Air Distribution Systems ▪ Lighting Controls ▪ Economizers The second change would require alternative performance criteria for some measures that would increase their potential to performing correctly in the absence of specific tests. For example, higher efficiency package HVAC equipment could be required in lieu of verifying economizer performance.
Compliance Option	The change would add a new compliance option. This option would have to be implemented in the ACM to account for the impact of reduced measure performance if the verification option is not selected.
Modeling	If performance verification is not required when using the performance approach, the certified programs would have to allow the derating of measure performance, should the verification option not be selected.
Other	The administrative chapter of Title 20 will be modified to describe the process necessary to certify providers who will verify measure performance. In addition, new compliance documentation requirements would be added.

Measure Availability and Cost

Third-party providers will enforce this requirement. The model being considered is similar to the CHEERS model for verifying duct performance in residential buildings. Because the option exists to comply without verifying performance (via enhanced efficiency in measure alternatives or other parts of the building), there will be a phasing-in period for the list of certified third parties. In addition, the recently formed California Commissioning Collaborative will work to develop this group of providers.

The baseline condition will vary by measure. For economizers, the baseline condition will be a minimum efficiency unit, with no economizer. The enhanced condition will include the cost of the economizer, plus the cost to perform the verification. Lighting controls and air distribution systems will be similar. For VAV and chilled water systems, performance verification may be required, and the costs would be based on using BAS for trend logging.

Costs for performing verification will be developed by monitoring utility-sponsored pilot programs, having existing commissioning providers give cost estimates, and through current residential duct sealing programs.

Useful Life, Persistence and Maintenance

The life and persistence of measure performance is an issue that touches all parts of the *Standards*. While a one-time verification process may deliver long-term savings over the life of some measures, it may not assure that other measures will deliver long-term savings.

For more sophisticated large-scale buildings and systems, a one-time, pre-occupancy performance check is far less likely to yield persistent savings. An example of this is chilled water plants where performance and efficiency is variable and highly dependent upon load, and chilled and condenser water temperature. Performance verification will only assure that long-term savings are not impacted by improper installation and start-up.

For these systems, the building owner could use BAS, which is already a part of the building project, as a means of verifying performance. By allowing this compliance method, it is possible to set the stage for continuous commissioning, performance verification, and diagnostics procedures over the life of the building and its systems.

Performance Verification

This proposal defines the requirements for performance verification.

Cost Effectiveness

It is key to realize that the savings for the measures requiring verification are an inherent part of the entire measure savings.

Therefore, performance verification does not have to be cost-effective on its own, but as a package when considering the cost of the measure, cost of verification, and savings associated with the measure. This approach will be used to determine the cost-effectiveness of the performance verification process. The process itself will not be subject to a separate cost-effectiveness analysis, independent of measure savings.

Analysis Tools

The current reference method is capable of providing results for the proposed approach. This method uses a probability function to estimate failure and proper operation. If the status of a broken system is something other than the absence of the measure (or a failure mode that falls outside current tool capabilities), then additional analysis tools may be necessary.

Relationship to Other Measures

This measure will impact the cost-effectiveness analysis and language of the measures that may be proposed by others for:

- Chilled Water Systems
- VAV Systems
- Package HVAC Systems
- Air Distribution Systems
- Lighting Controls
- Economizers

Bibliography and Other Research

Nonresidential Quality Assurance Project. *Verifying the Performance of New Nonresidential Buildings*, Final Report, April 30, 2001. www.newbuildings.org/downloads/codes/NRQAreport.pdf.

Johnson, J and Potter, A. *Incorporating a Method of Verifying Performance into California's Nonresidential Energy Standards: Opportunities and Obstacles*, National Conference on Building Commissioning, May 2001, PECI, Inc.